SHORT COMMUNICATION

Diet composition and prey selectivity by the spider *Oecobius concinnus* (Araneae: Oecobiidae) from Colombia

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Abstract. The feeding ecology of most *Oecobius* species is poorly understood; nevertheless, the limited literature available suggests that obligate myrmecophagy is common in this genus. Recent evidence suggests that some species might do not share this trait, but could be locally specialized predators. We describe the diet and prey selectivity of the spider *Oecobius concinnus* (Simon 1893), a common pantropical species. Samplings of actual and potential prey for this species were made in the city of Ibagué, Colombia. Ants were the dominant prey. Other prey included in its diet were dipterans. These results suggest that *O. concinnus* is not an obligate myrmecophagous spider. Nevertheless, further studies will evaluate other aspects of the biology of this species to reveal its trophic strategy.

Keywords: Stenophagy, prey selection, natural diet, synanthropic

Ants, being very abundant organisms in almost all terrestrial environments, are a potential food source for a wide range of predators (Hölldobler & Wilson 1990), but also have an arsenal of defenses that deter many potential natural enemies. Predators that routinely feed on ants (myrmecophages) are of particular interest in the context of understanding how the defenses of ants can be circumvented. Among spiders, 14 of 112 of the known families contain species that include ants on their diet (Cushing 2012). Yet, important questions remain concerning the level to which myrmecophagous spiders have become adapted to feeding specifically on ants. When a spider is found to be myrmecophagous, it also becomes of interest to determine whether it feeds occasionally on ants (opportunistic ant feeders) or includes them as the only prey in its diet (obligate ant feeders). The approaches for the study of myrmecophagy in spiders include observations of the natural diet and laboratory trials where adaptations for the consumption of ants can be tested (Huseynov et al. 2008). Nevertheless, studies about the diet composition of myrmecophagous spiders are scarce (Jackson & Nelson 2012).

Spiders of the genus *Oecobius* have been traditionally known for their extreme ant-eating habits, since some observations suggest that these spiders reject other arthropods as prey. Some authors even propose that this family presents modified structures like the gnathocoxae and reduced chelicerae as adaptations for ant consumption (Glatz 1967). Nevertheless, a recent study on the diet and feeding behavior of different populations of the spider *Oecobius navus* (Blackwall 1859), performed by Liznarová et al. (2013), showed that this species consumes other prey beside ants, and the frequency of consumption of certain prey items varies locally, contradicting the previous hypothesis about ants as the only prey.

In spite of this, the information about natural diet and feeding behavior of *Oecobius* spiders is limited, so it is unknown how prevalent extreme myrmecophagy is in this genus. In order to test whether other spiders of the genus *Oecobius* feed predominantly on ants or, as in the case of *O. navus*, catch a variety of arthropods, we analyzed the natural diet and studied the prey selectivity of *Oecobius concinnus* (Simon 1893), a pantropical species mainly associated with urban zones. If *O. concinnus* feeds only on ants, as suggested for other *Oecobius* species, we expected a diet composed exclusively of ants. A

marked selectivity of certain ant groups or subfamilies by *O. concinnus* could indicate whether it is a strict ant specialist, since a common trait of obligate ant specialists suggests that they prey more frequently on a certain ant subfamily, as has been shown for certain zodariid spiders, which feed mainly on formicine ants (Pekár 2004).

We evaluated the diet composition (i.e., actual prey) in populations of *O. concinnus* present in the urban area of Ibagué, Colombia, between November 2010 and January 2011. Spiders and their potential prey were sampled during 12 h, which were randomly distributed (one hour per day) on building walls at six different sites in the city; together, all the sampling points comprised an area of 6 m². Captured prey were removed from webs of adult females and subadult individuals (identified by size or presence of eggsacs inside the web), a procedure performed only once per web. Since carcasses of captured prey may remain attached next to oecobiid webs for some time (Voss et al. 2007), they most likely reflect prey consumed by the spider. Because some prey might become ensnared on the web without being consumed, and taking into account that *Oecobius* spiders always wrap their prey before feeding on them (Glatz 1967; Liznarová et al. 2013), only wrapped prey were considered in the diet analysis. Well-preserved specimens were deposited in the entomological collection of Southcolombian University (Universidad Surcolombiana).

The sampling protocol for potential prey followed the procedure used for actual prey. All arthropods found on the walls next to *O. concinnus* webs were sampled by two collectors during one hour. We searched crevices and other possible hiding places and placed the collected individuals in vials of ethanol (70%). Sampling hours of potential prey were randomly distributed at different daytime hours (one sampling hour per day); namely in the morning between 10:00–12:00 a.m., at noon, between 4:00–6:00 p.m. and in the night between 7:00–9:00 p.m. We used this procedure to collect potential prey with different circadian activities. We selected this sampling method since other techniques such as sticky traps, which ants can easily avoid, may not sample ants and other crawling arthropods adequately (Voss et al. 2007). Since *Oecobius* spiders build a sensing web (Cardoso et al. 2011) and mostly capture walking arthropods (Liznarová et al. 2013), our sampling method was focused towards crawling insects. In spite of this, we collected some flying insects that were found walking on the walls.

Prey captured by web were classified to the lowest taxonomic level allowed by their condition and grouped into morphospecies when the

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Table 1.—Percent of captured and available prey found in the same microhabitats as *Oecobius concinnus*. The category "others" includes arthropods of the groups Araneae, Blattodea, Collembola and Coleoptera.

Prey order	Captured (%)	Available (%)
Hymenoptera	99	94
Diptera	1	3
Others	0	3
N	223	527

species could not be identified. We measured selectivity for each species using the Savage selectivity index (Wi). This index measures selectivity as the ratio of each consumed prey, divided by the proportion of this prey among available prey. Statistical significance for this index was found using a chi-square test with a sequential Bonferroni Correction (Manly et al. 2002). Significant values for the chi-square test indicate a biased selectivity toward a certain prey species, while non-significant values indicate no selectivity. In order to evaluate similarity between species composition on actual and potential prey, we used the Morisita index (Krebs 1999). Statistical analyses for the Savage selectivity index were made within the software R for Windows 2.13.1 (R Development Core Team 2012). The Morisita similarity index was computed using the software Past 2.17c (Hammer et al. 2001).

We sampled 223 individuals and found the same number of captured prey (only one prey per web was found and collected). All collected prey belonged to the orders Hymenoptera and Diptera. For hymenopterans, the only recorded family was Formicidae, while for dipterans it was Chironomidae. We observed a marked prevalence of hymenopterans, which composed about 99% of the diet as opposed to dipterans, with only 1%. Potential prey were represented by 572 individuals grouped into six orders. The order Hymenoptera (Formicidae) was the most frequent, representing 94%, followed by Diptera with 3%. Other prey orders that showed a very low abundance (e.g., Araneae, Blattodea, Collembola and Coleoptera) were grouped in the category "others" and collectively represented 3% of available prey (Table 1).

Species composition was very similar (82%) between the actual and potential prey according to the Morisita index. There was a higher consumption of certain ant species like *Paratrechina* sp. and *Pseudomyrmex* sp. when compared to their availability; nevertheless, we did not find a marked selectivity for any of the prey consumed (Table 2).

Although the sampling period in our study was short compared to other descriptions of the diet composition in spiders, it sufficed to identify several prey species in the diet of *O. concinnus*, such as the dipterans, which had only been recorded for *O. navus* (Liznarová et al. 2013; Voss et al. 2007). The high capture frequency of ants by *O. concinnus* can be explained by the pronounced local abundance of this group compared to other prey. A similar tendency has been found in some theridiid spiders of the genus *Latrodectus*, which commonly include ants in their diet due to their high local abundance (Hódar & Sánchez-Piñero 2002; Salomon 2011).

The high capture frequency of four ant species is explained by their availability; since *Oecobius* builds a web on the wall surface, the possibility of capturing crawling prey is higher than that of flying prey. Additionally, the predatory behavior of *Oecobius*, which consists of wrapping prey with silk and biting it once it is immobilized, allows them to capture dangerous prey like ants (Glatz 1967). Interestingly, some of the ant species consumed by *O. concinnus*, namely *Camponotus* sp. and *Paratrechina* sp., are considered invasive urban pests and show a wide pantropical distribution (Bolton 1995; Wilson 1973; Hansen & Klotz 2005) similar to that of *O. concinnus* (Santos & Gonzaga 2003; Brazil et al. 2005). For this reason we suspect that these ant species are a common prey for several populations of *O. concinnus*. The capture of other prey beside ants indicates that *O. concinnus* is not a strict myrmecophagous spider; nevertheless, the high capture frequency of ants suggests that they are an important prey in the diet of this species. This tendency is also shared by some spiders of the families Theridiidae and Salticidae, which do not prey exclusively on ants, but include them commonly in their diet (Cushing 2012). Other traits, such as locating the web next to places where ants are very common, are shared by *O. concinnus* and the occasional ant feeding spider *Steatoda fulva* (Keyserling 1884; Hölldobler 1970), suggesting that the presence or abundance of ants could influence the web location of the former species. Additional studies should explore this aspect.

Since diet analysis by itself cannot reveal the complete trophic strategy of an organism, further experiments that analyze feeding choice and specialized predatory adaptations are needed to reveal whether the species is a trophic specialist. Future studies may assess whether the diet of *O. concinnus* varies locally like that of *O. navus*.

LITERATURE CITED

Bolton, B. 1995. A taxonomic and zoogeographical census of the extant ant taxa (Hymenoptera: Formicidae). Journal of Natural History 29:1037–1056.

Brazil, T.K., L.M. Almeida-Silva, C.M. Pinto-Leitel, R.M. Lira-da-Silva, M.C. Lima Peres & A.D. Brescovit. 2005. Aranhas sinantrópicas em três bairros da cidade de Salvador, Bahia, Brasil (Arachnida, Araneae). Biota Neotropica 5:163–169.

Cardoso, P., S. Pekár, R. Jocqué & J.A. Coddington. 2011. Global patterns of guild composition and functional diversity of spiders. PLoS ONE 6:e21710.

Table 2.—Savage's selectivity analysis (Wi) of *Oecobius concinnus* over different prey types (ant subfamilies are indicated inside brackets). Only one morphospecies from the family Chironomidae was found.

Prey species	Captured (%)	Available (%)	Wi	P
Camponotus sp. (Formicinae)	27	30	0.92	0.70
Neivamyrmex sp. (Dolichoderinae)	27	45	0.60	0.40
Paratrechina sp. (Formicinae)	23	14	1.67	0.54
Pseudomyrmex sp. (Pseudoyrmicinae)	21	7	3.06	0.14
Chironomidae	1	4	0.33	0.76

Cushing, P.E. 2012. Spider-ant associations: an updated review of myrmecomorphy, myrmecophily, and myrmecophagy in spiders. Psyche 2012 (Art. ID 151989):1–23.

Glatz, L. 1967. Zur biologie und morphologie von *Oecobius annulipes* (Araneae: Oecobiidae). Zoomorphology 64:185–214.

Hammer, O., D. Harper & P. Ryan. 2001. PAST: Paleontological statistics software for education and data analysis. Paleontologia Electronica 4:1–9.

Hansen, L. & J. Klotz. 2005. Carpenter Ants of the United States and Canada, first edition. Comstock Publishing Associates, Ithaca, New York, USA.

Hódar, J.A. & F. Sánchez-Piñero. 2002. Feeding habits of the black widow spider *Latrodectus lilianae* (Araneae: Theridiidae) in an arid zone of southeast Spain. Journal of Zoology 257:101–109.

Hölldobler, B. 1970. *Steatoda fulva* (Theridiidae), a spider that feeds on harvester ants. Psyche 77:202–208.

Hölldobler, B. & E.O. Wilson. 1990. The Ants. Springer-Verlag, Berlin, Germany.

Huseynov, E.F.O., R.R. Jackson & F.R. Cross. 2008. The meaning of predatory specialization as illustrated by *Aelurillus m-nigrum*, an anteating jumping spider (Araneae: Salticidae) from Azerbaijan. Behavioural Processes 77:389–399.

Jackson, R.R. & X.J. Nelson. 2012. Specialized exploitation of ants (Hymenoptera: Formicidae) by spiders (Araneae). Myrmecological News 17:33–49.

Krebs, C.J. 1999. Ecological Methodology, second edition. Benjamin/Cummings, Menlo Park, California, USA.

Líznarová, E., L. Sentenská, L.F. García, S. Pekár & C. Viera. 2013. Local trophic specialisation in a cosmopolitan spider (Arancae). Zoology 116:20–26.

Manly, B.F.J., L.L. McDonald, D.L. Thomas, T.L. McDonald & W.P. Erickson. 2002. Resource Selection by Animals: Statistical Design and Analysis for Field Studies, second edition. Kluwer Academie Publishers, Boston, Massachusetts, USA.

Pekár, S. 2004. Predatory behavior of two European ant-eating spiders (Araneae, Zodariidae). Journal of Arachnology 32:31–41.

R Core Team. 2012. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Santos, A.J. & M.O. Gonzaga. 2003. On the spider genus *Oecobius* Lucas, 1846 in South America (Araneae, Oecobiidae). Journal of Natural History 37:239–252.

Salomon, M. 2011. The natural diet of a polyphagous predator, *Latrodectus hesperus* (Araneae: Theridiidae), over one year. Journal of Araehnology 39:154–160.

Voss, S.C., B.Y. Main & I.R. Dadour. 2007. Habitat preferences of urban wall spider *Oecobius navus*. Australian Journal of Entomology 46:261–268.

Wilson, E.O. 1973. The ants of Easter Island and Juan Fernandez. Pacific Insects 15:285–287.